

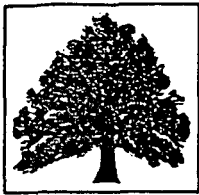
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**RESPONSE TO COMMENTS ON THE SOIL-GEOSYNTHETIC INTERFACE
DIRECT SHEAR TESTING WORK PLAN**

06/05/96

**DOE-0988-96
DOE-FN EPAS
13
RESPONSES**



Department of Energy

**Ohio Field Office
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**JUN 5 1996
DOE-0988-96**

**Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590**

**Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
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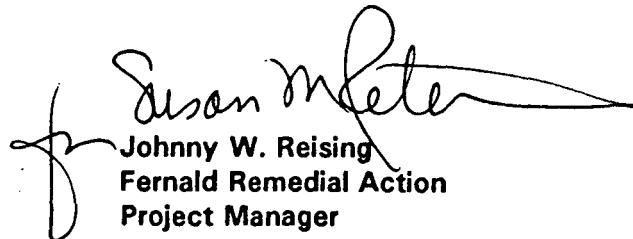
Dear Mr. Saric and Mr. Schneider:

**RESPONSE TO COMMENTS ON THE SOIL-GEOSYNTHETIC INTERFACE DIRECT SHEAR
TESTING WORK PLAN**

Enclosed is the Response to Comments for the Soil-Geosynthetic Interface Direct Shear Testing Work Plan. If there are no additional comments from the U.S. Environmental Protection Agency (U.S. EPA) or the Ohio Environmental Protection Agency (OEPA), then the revisions will be incorporated and the appropriate pages forwarded for inclusion into the Work Plan.

If you have any questions, please call Rod Warner at (513) 648-3156.

Sincerely,


**Johnny W. Reising
Fernald Remedial Action
Project Manager**

FN:Jalovec

Enclosure: As Stated

cc w/enc:

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**RESPONSES TO OEPA COMMENTS
SOIL-GEOSYNTHETIC INTERFACE DIRECT SHEAR
TESTING WORK PLAN
ON-SITE DISPOSAL FACILITY**

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: General

Page #:

Line #: NA

Code: C

Original Comment #: 1

Comment: *Please explain the methods for statistical analysis of data and the procedure for retesting or eliminating test outliers, for example, if one or more of the tests conducted at different normal compressive stresses are inconsistent with previous results. Further, please see comments on Appendix B, page B6 for questions regarding the statistical analysis of data obtained from different laboratories.*

Response: The majority of the proposed direct shear test series (i.e., 19 out of 22 series) consist of three independent direct shear tests of individually constructed samples, each conducted at a different normal stress. A straight line representing the shear strength parameters is fitted through the three data points from each test series. If one of the three tests does not correlate with the other two and is suspected of being erroneous, the test is rerun. Indicators of the need to rerun a test are correlation coefficient much less than one and a strain hardening behavior. In the absence of specific requirements in the testing standard, the experience of the laboratory professionals is relied upon to cull outliers or inconsistent results and retest points as necessary. Comments regarding the use of different laboratories are addressed in response number 6 below.

Action: No action needed.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: General

Page #:

Line #:

Code: C

Original Comment #: 2

Comment: Under ASTM D5321, determination of post test density and moisture contents are optional, section 11.9, page 411. Post test densities and moisture contents should be determined under the current work plan?

Response: Under the current work plan, post-test moisture content measurements are made, but not post-test density measurements. Post-test density measurements are not made because the data are not used in the evaluation of test results or in liner system/final cover system performance analyses. Post-test moisture measurements are made to verify moisture conditioning and expected trends in moisture contents resulting from sample wetting.

Action: No action needed.

Commenting Organization: Ohio EPA
Section #: General **Page #:**
Original Comment #: 3

Commentor: GeoTrans
Line #: **Code:** C

Comment: As related to General Comment 2, final moisture contents and density determinations should be determined using a sample taken from the shear zone, please modify the text.

Response: See response number 2 above for discussion of moisture content and density measurements. The text will be modified to require moisture contents samples to be taken from the shear zone.

Action: Section 2.2 will be revised to add the sentence, "A post-test moisture content measurement in accordance with ASTM D2216 will be made at the shearing interface of all soil samples."

Commenting Organization: Ohio EPA
Section #: General **Page #:**
Original Comment #: 4

Commentor: GeoTrans
Line #: **Code:** C

Comment: *What steps are being taken to insure that the modes of failure produced in the laboratory are consistent with the failure modes expected or previously observed in the field. If the modes of failure are different, what adjustments will be made to the laboratory determined values?*

Response: In the laboratory testing, specimens are constrained to fail at the indicated interfaces. The mechanical set-up of the testing apparatus prevents any other failure mode. The scope of the laboratory testing program, as described in the SGIWP Section 2.1, includes those interfaces for which site-specific data are required and those for which existing data are considered insufficient for design. It is important to note that the interfaces being tested are the ones that will lead to the lowest factors of safety for slope stability.

Action: No action required.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: General

Page #:

Line #:

Code: C

Original Comment #: 5

Comment: *It is assumed that all GCL testing will be performed using tap water for hydration. Information on GCL performance depending on the first exposure of actual hydrating liquids should be included. What types of leachate or site groundwater is expected to hydrate the GCL and how will this effect performance?*

Response: It is expected that significant hydration of the GCL could only occur from exposure to water used in the moisture conditioning of the clay layer or rainwater from precipitation events during the construction of the liner system. Tap water is appropriate for hydration of test specimens because it is representative of both rainwater and water to be used for moisture conditioning of the clay layer (OSDF specifications will require that potable water be used for moisture conditioning). The potential for hydration of the GCL by leachate is not considered significant because such hydration could only occur at defects in the overlying geomembrane and could therefore affect only localized areas.

Furthermore, information in the Leachate/Liner Compatibility Work Plan on likely leachate characteristics indicates that leachate will not adversely affect the shear strength characteristics of the GCL.

Action: No action required.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: Appendix B Page #: B6

Line #: Code: C

Original Comment #: 6

Comment: *Two laboratories are listed: 1.) GeoSyntec Consultants Interaction Testing Laboratory and 2.) Geomechanics and Environmental Laboratory, both in Atlanta, Georgia. Please explain the scope of testing services to be performed by each of the labs. Further, under ASTM D5321, comparative tests to determine whether a statistical bias exist between laboratories is required. Are data from the laboratories currently available for a comparative analysis?*

Response: The role of the GeoSyntec Soil-Geosynthetic Interaction Testing (SGI) Laboratory is to perform interface direct shear testing in accordance with ASTM D 5321. The role of the GeoSyntec Geomechanics and Environmental Laboratory (GEL) is to evaluate the Atterberg limits of the soil specimen in accordance with ASTM D 4318 and to perform compaction testing of the soil in accordance with ASTM D 698. Since the laboratories do not perform the same testing, comparative testing to determine any statistical bias between laboratories is not needed.

Action: Section 2.3 will be revised to add the following narrative: "Soil characterization testing, i.e. Atterberg limits and standard Proctor compaction, will be performed by the GeoSyntec Geomechanics and Environmental Laboratory (GEL). Testing procedures will be in accordance with the applicable ASTM and the *Geomechanics and Environmental Laboratory Operations and Procedures Manual*."

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: Appendix A **Page #:** 410

Line #: Note 7 **Code:** C

Original Comment #: 7

Comment: *The frictional characteristics of some geosynthetics may depend on the direction tested. Are the geosynthetics being tested under this workplan directional? If so please modify the workplan to account for the directional effects.*

Response: The shear strength of some geosynthetic-soil and geosynthetic-geosynthetic interfaces will vary with the direction of shear. In setting up the work plan, it was assumed that the primary direction of any interface slippage would be in the geosynthetic machine direction. This assumption is appropriate for the final cover system. The assumption may not always be appropriate for the liner system during impacted material placement (interim conditions). However, since the influence of direction of shear on the geosynthetic components of the liner system (i.e., geomembranes, nonwoven geotextiles, and GCLs) is believed to be small, and since calculations have shown that the minimum factor of safety for these interim conditions significantly exceeds the target value of 1.3 when typical strength values are used, there is no plan to test the interface shear strengths in other directions.

Action: If testing program results indicate the potential for unexpectedly low interface strengths between available materials, a requirement will be placed in the OSDF specifications that quality control testing be performed to demonstrate that available materials have adequate interface strengths in both machine and cross-machine directions.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: 2.0

Page #: 2-3

Line #: Table 2-2

Code: C

Original Comment #: 8

Comment: *Information on the "site specific clay" is listed in Table 2-2 as "sufficient information to design". However, based on the known sensitivity of the proposed tests to the site specific clay, additional tests on the site-specific clay may be warranted. This information would provide valuable insight into the usefulness of previous test results.*

Response: It should be noted that the specific design information to which the table refers is the internal shear strength of the clay. GeoSyntec's experience is that the interface being tested will always be weaker than the internal shear strength of the clay. The notation that there is "sufficient information to design" for the site-specific clay is based on the extensive testing of soils which has been performed to-date. The cited Parsons reference presents data from the results of a geotechnical investigation of soils in the footprint of the OSDF. An additional geotechnical investigation report on soils in the borrow area is in preparation by Parsons. The initial borrow area investigation results have been examined and appear to support the material characteristics and properties given in the cited reference.

Action: No action required.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: 2-3

Page #: 2-6

Line #:

Code: C

Original Comment #: 9

Comment: *Please provide further information on the representative nature of using a clay with a high plasticity for shear testing. Why is this a conservative analysis? Is this material to be used in construction of the liner material?*

Response: As noted in section 2.3 of the SGIWP, the soil material to be used in the testing program will be representative of the portions of the brown till with average or greater plasticity. The brown till is the material anticipated to be used for the compacted clay components of the liner system and final cover system. In addition, the supplemental soil material to be used in the testing program will be representative of the portions of the brown till with the highest plasticity.

Published geotechnical research (e.g., Lambe and Whitman, 1969, Figure 21.4) has shown that soil shear strength generally decreases as the plasticity index of a soil increases. It has also been shown that the interface shear strength between a geosynthetic and a soil is typically a

percentage of the soil shear strength when similar geosynthetics are tested. Therefore, the higher the plasticity of the soil used in the interface shear testing program, the lower the expected value of interface shear strength. For this reason, it is conservative to test soils that have higher plasticity than the average soils anticipated for use in construction.

Action: No action required.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: 2-3

Page #: 2-5

Line #:

Code: C

Original Comment #: 10

Comment: Please provide reasons for using a Proctor compaction test versus the modified Proctor. Further, what data were used to specify 95% of Proctor, 5% wet of optimum, and 98% of Proctor, 2% wet of optimum.

Response: A standard Proctor compaction criterion has been chosen because it more closely simulates the actual compactive effort expected to be used for construction of the clay components of the liner and final cover system. The density and moisture content that will be used for the majority of the laboratory tests, 95 or 98 percent of maximum dry density and 3.5 or 2 percent wet of optimum moisture, represent the most probable range of conditions to which the clay will be compacted during OSDF construction based on the available soil testing information (Parsons, 1995). These density and moisture contents are also representative of the conditions to which the test pad will be constructed. One laboratory test series (i.e., Test Series 10) will be conducted using an additional range of density and moisture conditions to provide comparative information in case that the test pad program results indicate that the required compaction conditions differ significantly from those chosen for the majority of the interface shear tests.

Action: No action required.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #: 2-4

Page #: 2-7

Line #: Code: C

Original Comment #: 11

Comment: Two shear rates are proposed, 0.04 in./min and 0.004 in./min. The slower rate will provide information to assess the effect of slower shear which is more representative of a drained condition. However, based on the relatively large sample size (12 inches by 12 inches) and the low permeability, a fully drained condition will likely not occur. How was the slower rate selected and how would the evaluation of the test results differ under the drained and undrained assumptions. See ASTM D5321, page 411, Note 9?

Response: Two shear rates are used to provide a basis for assessing the effects of shear rate on interface shear strength. The faster rate is equal to the default rate given in ASTM D 5321 for soil-geosynthetic interfaces. The slower rate was selected to be an order of magnitude slower. This difference is sufficient to provide an indication of shear rate effects. The results from the tests at both shear rates will be evaluated using a total stress approach is possible because pore pressures are not measured during the testing.

Action: An interpretation of the test results with respect to rate of shear will be given in the final report.

Commenting Organization: Ohio EPA

Commentor: GeoTrans

Section #:

Page #: 2-7

Line #:

Code: C

Original Comment #: 12

Comment: The time for soaking of the GCL has been specified at 168 hours. Please provide information pertaining to reasons for selecting 168 hours. Is this time sufficient to hydrate the GCL to a swell rate of less than 5%?

Response: A soaking time of 168 hours (7 days) was chosen because experience indicates that during this period the GCL will hydrate to a moisture content above 100 percent. For example, Daniel, et al. [1993, Figure 5] show that even GCLs placed in contact with nominally dry sands will

hydrate to a moisture content of 100 percent within this time. Daniel et al. [1993] also indicate that reduction in GCL shear strength due to hydration is essentially fully achieved when the moisture content exceeds 50 percent. Based on this information, even if swelling has not completely ceased at the end of the 168-hour soaking period, hydration will be sufficient, for practical purposes, to cause full reduction in GCL shear strength.

Action: No action required.

REFERENCES

Daniel, D.E., Shan, H.-Y., and Anderson, J.D., "Effects of Partial Wetting on the Performance of the Bentonite Component of a Geosynthetic Clay Liner", *Proceedings of the Geosynthetics '93 Conference*, Vancouver, Canada, Feb 1993, 1483-1496.

Lambe, T.W., and Whitam, R.V., *Soil Mechanics*, Massachusetts institute of Technology, John wiles and Sons, Inc. New York, 1969.

Parsons, "Geotechnical Investigation Report On-Site Disposal Facility", Revision 0, November 1995.

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**RESPONSE TO U.S. EPA COMMENTS
SOIL-GEOSYNTHETIC INTERFACE DIRECT SHEAR
TESTING WORK PLAN
ON-SITE-DISPOSAL FACILITY**

Commenting Organization: U.S. EPA

Commentor: Saric

Section#: General Comment

Pg. #: **Line#:**

Code: C

Original Comment# 1

Comment: *"Figure 2-1 should show the location from which the supplemental samples of clay soil will be collected and an explanation as to why GeoSyntec plans to perform such tests on the geosynthetic materials."*

Response: Agree. Figure 2-7 will be revised to show all clay sample locations. Section 1.0 will be revised to note that shear strength test results will be provided as friction angles along slip surfaces and used in the evaluation of liner and cover system stability. NOTE: See Intermediate Design Calculation Package On-Site Disposal Facility, Volume 1, Section 3, Calculations 3.2 and 3.5.

Action: Revise Figure 2-1. Page 1-1 - Add at end of fourth paragraph. See On-Site Disposal Facility Design Calculation Package Calculation Numbers 3.2 and 3.5.